PETROLEUM

Project Fact Sheet

Advanced Method of Inspecting Tubular Goods and Refinery Process Piping

Benefits

- Provides detailed non-destructive material analysis via ultrasonic inspection of the complete circumference and volume of the tubular material
- Offers on-line inspection capability
- Eliminates need for fluid couplants and rotation
- Operates on ferrous or alloy materials
- Lowers maintenance costs substantially

Applications

This technology is primarily applicable for use by tube manufacturers and energy-exploration companies. Secondary applications are possible in the utilities, chemicals, refining, mining, and pulp and paper industries, which depend on pipe to move product. Two distinct versions of the technology are being created. One will function in a factory environment, where multiple transducer pairs will allow on-line inspection to occur during manufacturing. The other will be portable and designed for use in the field to inspect pipe prior to or in service.

An advanced analysis method provides complete on-line ultrasonic inspection of tubular material without rotation or fluid couplant

Refinery process piping and tubulars are inspected either by electromagnetic imaging (EMI) or conventional ultrasonic (UT) test systems. The EMI method is inexpensive and rapid, but also less sensitive to internal imperfections and can be used only on ferrous materials. Conversely, the UT approach is sensitive to internal as well as external flaws and can operate on non-ferrous material. However, production throughput with a UT system is up to 10 times slower than with an EMI system and conventional UT systems require special handling. Specifically, either the tube or the sensors must be rotated in a continuous fluid-couplant medium.

In refineries and chemical plants, in-situ process piping is not currently inspected fully due to the absence of an adequate inspection technology. Spot readings are taken at accessible points along the material, but these readings represent coverage of less than 1 percent of the total material. Often, critical inspection points, such as pipe-support areas, are inaccessible to inspection.

An advanced technology has been developed and is being refined and commercialized to detect and classify defects and imperfections in tubular goods using electromagnetic acoustic transducers (EMAT) technology. This innovative, new approach uses ultrasonic waves, which are launched around the tube. As the sensor array traverses the tube and generates a *global* inspection, defects in the material affect the phase and amplitude of the received signal. This new technology is able to detect manufactured or service-induced defects such as cracks, pitting, and general wall loss.

Advanced Ultrasonic Method Analyzes Piping Near and at Support

This advanced technology allows accurate global inspection of tubular goods by using ultrasonic waves to detect defects in the material, including cracks, pitting, and general wall loss.

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Project Description

Goal: Develop an operational, portable prototype inspection system capable of rapidly and cost effectively identifying and classifying defects in the walls of tubular goods.

Concentrating on the amplitude and phase shift of the return sound wave, this new system more accurately detects and classifies defects, as well as marks the tube appropriately for examination. It inspects at production line speeds from 3 to 30 times faster than conventional technologies. The technology does not require fluid couplants or special handling of the tubes, creating an easier, less labor-intensive system.

This advanced method of inspecting tubular goods or process piping represents an advancement in inspection technology, with its innovation in the transducers, the associated circuitry, and the proprietary software. The new system's EMAT technology addresses inspection limitations in three distinct industries—tube manufacturing, generic, and industrial process piping. The technology has addressed the deficiencies of conventional EMI and UT systems, which means lower costs and higher efficiencies in the inspection process.

Progress and Milestones

- Components of EMAT have been designed, assembled, and tested, in the lab and field.
- Redesigned EMAT coil and magnet system has been tested and certified for use.
- Unique precision-timing circuitry has been designed, tested, and is in commercial production.
- Novel high-current EMAT drivers have been designed and tested.
- Several of the largest petrochemical companies have approved the technology. American Petroleum Institute (API) members' evaluations yielded commercial approval.
- Work continues to assemble a production prototype of the portable unit, to demonstrate the portable unit in a full-scale manner, and to complete limited production runs of the unit. The company is working towards securing necessary approvals and certifications by demonstrating its first commercial prototype of the technology.

Economics and Commercial Potential

Tubular goods are a single-market group of carbon and alloy steel products that are either electric-resistance-welded or seamless tubing, piping, and casing, which are used downhole in oil and natural gas wells and in industrial process piping. Suppliers of tubular goods reported market growth in the mid to late 1990s, and this growth has continued into the 21st century. Demand grew by an average 32 percent annually for the period 1996 to 1997, bringing 1997 consumption to 2.29 million tons.

EMAT offers the potential for significant energy savings for both pipe manufacturers and third-party tubular goods inspection companies and tube/pipe end users. It conserves energy during the testing operation, because it is faster than existing systems. Energy savings will also be realized during the manufacture and testing of tubular goods. More accurate testing methods will improve the quality of the tubulars employed in energy exploration and in transporting fluids, resulting in fewer tubular failures. Energy will also be saved by avoiding start and stop product losses associated with pipe failures.

The Office of Pipeline Safety indicated that between 1986 and 2000, there were 6,000 accidents, 300 fatalities, $1 billion in damage, and 1.6 million barrels lost. Since approximately 10 percent are known applicable causes, 1-percent avoided damage would equal about $60 million annually from pipelines alone. This does not count industrial accidents where proximity most likely causes more severe losses.

Industry of the Future—Petroleum

Petroleum is one of nine energy- and waste-intensive industries that is participating with the U.S. Department of Energy's (DOE) Office of Industrial Technologies' Industries of the Future initiative. Using an industry-defined Vision of the petroleum industry in the year 2020, the industry and DOE are using this strategy to build collaborations to develop and deploy technologies crucial to the industry's future.

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The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

Project Partners

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